Chapter 3

VEGETATION CONTROL IN SEMI-IMPROVED AND UNIMPROVED GROUNDS

Section A—Methods of Vegetation Control

3-1. Earth Forms and Structures. A number of earth forms and structures can contribute to the case and success of weed-control practices.

a. Embankments, fences, floodways, tank farms, road and utility rights-of-way, and similar areas should be designed, constructed, and managed in a manner to enhance efficient vegetation management. Ditchbanks should be shaped to provide uniform crowns and slopes, and a roadway should be maintained on each bank for efficient use of mowers and spraying machinery. Shaping ditches, grades, and backslopes along highways to avoid steep or irregular contours provides similar benefits.

b. Providing suitable livestock guards, instead of gates, greatly facilitates access to the area when using livestock grazing for weed control.

3-2. Land Management Practices:

a. Seeding areas such as magazines, ditchbanks, fence lines, and rights-of-way to low-growing grasses or other desirable plants usually provides sufficient competition to reduce the weed problem greatly. It will also increase the effectiveness and economy of grazing, mowing, or using selective herbicides for vegetation control. Maintaining desirable vegetation on these areas prevents or reduces wind and water erosion and provides habitat for wildlife. Establishing suitable stands of the desired competitive vegetation is much easier on recently constructed ditchbanks, road rights-of-way, and similar areas than on those already heavily infested with weeds. Frequently, weed growth can be eliminated by spraying with nonpersistent herbicides, such as paraquat and glyposate. Then a grass or other revegetation mixture can be seeded almost immediately and successfully established.

b. Controlled grazing by cattle, sheep, goats, and geese, where feasible, often provides effective and economical means of vegetation control on ditchbanks and floodways. Only a few biological agents other than livestock effectively control weeds. Examples are insects that control Scotchbroom, gorse, punctureVine, and St. Johnswort in uncultivated areas, and alligatorweed in aquatic sites. Also, wild ducks, Tilapia, and grass carp eat aquatic vegetation. Removing sources of excess nitrogen, which encourages the growth of aquatic plants, is another means of controlling aquatic weeds.

c. Repeated mowing tends to eliminate or reduce tall weed species, and encourages the dominance of more desirable low-growing vegetation. Mowing may need to be repeated three to eight time each growing season to maintain effective control of undesirable plants.

3-3. Recommended Herbicides:

a. Attachments 6, 7, 8, and 9 list herbicides that are recommended for semi-improved and unimproved grounds. Herbicides that kill all vegetation are listed in attachment 6; while attachment 7 contains those that work best on broadleaf weeds without killing the grasses. Attachment 8 contains those primarily controlling grasses. Herbicides for woody plants are given in attachment 9. Rates of treatment and instructions for use are abbreviated. More detailed information is included on labels and company brochures for each of the herbicides. Follow the instructions completely. The approximate retail prices given in the attachments may be useful in preliminary planning. Actual costs will be somewhat different.

b. The low-volatile esters of 2,4-D and other phenoxy herbicides must be used with caution near agricultural crops and improved grounds when drift or volatilization could damage ornamentals or desirable plants. The high-volatile esters should not be used in these situations. The amine salt formulations do not volatilize, but the sprays may drift. These also should be used with care.

Section B—Controlling All Vegetation

3-4. Problems With Bare Soil. These problems are not always fully appreciated.

a. Controlling all vegetation, and thus leaving the soil bare, has such great disadvantages that the method should be used very sparingly and

only after fully considering potential consequences and alternatives. Bare soil erodes both by water movement and by wind. The loss of soil maybe accompanied by rill and gully erosion, and the dust problem from wind erosion may be considerable. Also, water erosion of soil often carries the herbicides with it and may severely injure or kill desirable grasses, woody plants, or other vegetation in downslope areas. Mowing existing vegetation may adequately maintain a site for its planned use. Maintaining low-growing grasses or other vegetation is almost always preferable to having the soil bare.

b. There are four major considerations in maintaining bare ground:

(1) No herbicide kills all species at reasonable rates of application.

(2) Reinfestation results from weed seeds in the soil after the herbicide has been leached below the surface.

(3) Desirable trees, ornamental plants, and turf in adjoining areas may be killed or injured if surface water drains across treated areas to untreated ones, or it tree roots extended into treated areas.

(4) Bare soil is subject to serious erosion where the terrain is steeply sloped and there is enough rainfall to cause runoff. You should meet these problems by using the most appropriate herbicide treatment for the situation, and by using soil binding or stabilizing treatments or structures to prevent erosion.

3-5. Using Soil Sterilants. There is no one herbicide available that meets all requirements for complete control of vegetation.

a. At practical rates of application, even the soil sterilants do not always kill all vegetation. There are two major reasons. First, each of the soil sterilants listed in this publication has one or more plant species that is tolerant to it; and, second, these herbicides do not behave equally well under all environmental conditions.

b. Soil sterilants prevent the growth of green plants. They do not actually sterilize the soil. To be effective, a soil sterilant must be soluble enough to be carried into the root zone by moisture in the soil. Also, it must remain in the soil long enough for a lethal dose to be absorbed by the plant. A soil sterilant's movement and persistence in the soil are influenced by (1) its solubility; (2) the rainfall in the area; (3) the physical and chemical properties of the soil, such as texture, structure, and pH; (4) organic matter; and (5) the micro-organisms in the soil that are able to deactivate the chemical.

c. The rate of application and the optimum time for treatment vary with soil, rainfall, and the weed species to be controlled. In most areas, it is better to make repeated annual applications of soil sterilants at relatively light rates than to rely on a single heavy treatment. Such a maintenance dosage results in a smaller annual expenditure than a "one-shot" method and keeps chemicals in the surface soil where they can kill weed seeds coming in from outside or that may have been dormant in the soil. The full effectiveness of some soil sterilants like bromacil, tebuthiuron, diuron, and simazine is most evident in the second or third year of use, especially in dry areas or with deep rooted weeds.

d. Broadleaf species are usually the first vegetation to reinfest sterilized areas. Relatively inexpensive supplemental treatments with esters 2,4-D at 1 to 2 pounds per acre, or other herbicides in attachment 7, will maintain areas free of tall vegetation for several additional years. Make spot treatments of the difficult-to-kill plants by hand at rates high enough to kill the tolerant weeds rather than making another general spray treatment.

e. Failure to get expected control may result from an incomplete distribution of the herbicide on the soil or from inadequate amounts in the soil solution to effect a kill. A chemical of low solubility may be adsorbed in the upper soil layer and not reach deeper roots. This may happen in soils with poor underdrainage, in dry regions, or when the treatment is made at the wrong time. A soluble chemical may leach out of the soil before the plant roots absorb a lethal dose. This occurs most commonly in sandy soils having excessive underdrainage and with high rainfall, seasons of heavy showers, or under irrigation. It may result from improper timing of the treatment. A number of actions can be taken when hard-to-kill species are a problem, or where environmental factors reduce the activity of a chemical: (1) increase the rate of application, (2) use a mixture of chemicals, or (3) repeat the treatment.

f. Runoff is an important hazard on treated slopes, bare ground, and pavements. Low viscosity asphalt, applied after application of a soil sterilant, helps hold the chemical in place. Use 40 gallons per 1,000 square feet, or 1,700 gallons per acre, or use a light covering of road oil. If there has been an excavation, add a layer of crushed rock. Trees that are some distance from soil treated with soil sterilants may be killed if their roots extend into the treated area.

3-6. Control With Combinations of Herbicides. A combination of herbicides may be more efficient for complete control of vegetation than a single chemical. Combinations of different herbicides effectively increase the range of weed species controlled; and, in some cases, reduced rates of herbicides are possible.

a. To obtain vegetation-free areas, certain foliar-applied herbicides are used together with persistent, soil-applied herbicides. These foliar herbicides include the contact herbicide paraquat and the translocated herbicides such as glyphosate and amitrole. Glyphosate is nonselective and kills many weeds, including perennial weeds. It readily translocates from the foliage to other parts of the plant, including the roots. It has no soil activity. Where the perennial weeds are susceptible to the growth-regulator herbicides, it may be economical to use a combination of a relatively insoluble soil sterilant like bromacil, simazine, or diuron to control annual weeds and 2,4-D, dicamba, or other such growth-regulator herbicide to kill the broadleaf perennials.

b. Soil sterilants are applied preemergence to moist soil at about 4 pounds per acre. The growth-regulator herbicides are applied to broadleaf perennials at 1 to 2 pounds per acre when they are in full leaf and growing rapidly to obtain the maximum translocation to their roots. For this combination method to be successful, the soil sterilant must remain near the soil surface, and there must be enough rainfall to activate it. Heavy rain will leach the herbicide from the topsoil and shorten the period of control. Incorporation of the chemical into the soil helps activate it in dry seasons, but this does not substitute for train.

Section C—Controlling Woody Vegetation

3-7. Practical Considerations. Each type of land use influences the methods that can be used for brush control.

a. On military reservations, trees and shrubs sometimes must be removed or controlled on weapons ranges, ammunition magazines, and similar areas. Woody plants must also be kept under control along highways, under power lines, along security fences, and at the end of aircraft runways.

b. Woody growth can be cut mechanically or manually. Stumps can be removed by bulldozer, if required. Root rakes may be used for more thorough removal of roots. Sprouts and stems less than 2 inches in diameter can be mowed with a heavy-duty rotary mower. If stumps are not removed or treated with herbicides, resprouting will require repeated rotary mowing. Mowing is impractical on rough and rocky terrain. One or two mowings per year are usually adequate, but such mowing becomes a continuing requirement.

c. Where mechanical removal is not possible or practical, herbicides may be applied from the air or the ground, using either sprays or pellets. Both selective and nonselective herbicides for killing woody plants are available and are applied in various ways, depending on the plants to be treated, their geographical location, and the proximity of valuable crop and ornamental plantings. Effective herbicides are shown in attachment 9.

3-8. Foliage Sprays. These may be applied as drenches or as low-volume treatments.

a. The drench treatment attempts to wet all foliage, twigs, and terminal limbs. Drenching sprays are used to kill brush along roads, rights-of-way, fences, and drainage ditches. Drenches are applied by high-volume sprayers capable of maintaining pressures up to 100 pounds per square inch. Higher pressures tend to form excessively by fine spray droplets that are more likely to drift off target. High-volume refers to 100 or more gallons per acre. The high-volume applications are often used in areas that are too small for aerial applications or in sites that are not practical for low-volume equipment. High-volume applications are usually made by hand-held or turret-mounted spray guns with adjustable nozzles.

b. Low-volume sprays, usually from 5 to 40 gallons per acre, are applied by aerial, ground, or hand-held sprayers equipped with booms, boomless nozzles, or mist blowers. Aerial spraying is best for treating rough terrain and large areas of tall and dense brush. Aerial spraying can give good coverage of the area being

treated. In densely wooded areas, however, the spray that penetrates to the lower levels often is inadequate to kill understory plants. A second aerial spraying may be necessary a year or two after the first.

c. When applying spray by aircraft, instruct the pilot to fly as close to the top of the brush as safety allows. Use experienced flagmen or guides on the ground to mark individual spray swaths to guide the pilot. Flagmen should move upwind during flagging to minimize their exposure to spray drift. Swath width should not exceed 1.5 times the wing span or bladespan of the aircraft.

d. The possibility of drift, and in some case volatilization, must be dealt with in any spray application. None of the herbicides discussed in this publication are high-volatile esters. However, low-volatile esters of phenoxy herbicides can volatilize at high-temperatures, especially above 90°F. Even with products that do not volatize, proper precautions should be taken to avoid drift to nontarget areas in a spray application (figure 2-2).

e. All crewmembers should review applications techniques before the application season begins. Also, before application is begun on a site, a reconnaissance should be made of the area to be treated. Streams, impounded water, crops, gardens, dwellings, buffer zones, and roads should be delineated on a map. Avoid applying herbicides where they are not wanted. Except for herbicides registered for use on lawns and ornamental plantings, plan to leave unsprayed zones of vegetation around gardens, dwellings, or other buildings housing people or serving as public gathering places. Avoid spraying herbicides, other than aquatic herbicides, directly into flowing streams, drainage ditches, and impounded water.

3-9. Basal Sprays. Some herbicides kill trees if applied to the trees' lower trunks.

a. Basal sprays are applied to the bark of individual trees up to 5 inches in diameter. They can be used at any time of the year, but effectiveness is reduced when the bark or soil is wet.

b. Herbicides used in this manner include esters of 2,4-D and other phenoxy herbicides mixed in diesel oil or kerosene. Usually mix at a rate of 12 to 16 pounds of herbicide in 100 gallons of oil. Water is an ineffective carrier. Other herbicides are also used as basal sprays.

c. Apply basal spray to the lower 12 inches of the woody plant to be killed. Wet the bark thoroughly all around the stem. Apply until it runs down the stem to the base. One gallon of spray is enough to treat about 50 trees 2 inches in diameter or 33 trees 3 inches in diameter.

d. Apply the herbicide with a compressed air sprayer, knapsack sprayer, or power sprayer. Pressures from 10 to 40 pounds are adequate. A 15 to 20 degree fan-type nozzle set at a 45 degree angle to the spray wand is preferred.

3-10. Cut Surface and Injection Treatments:

a. Trees larger than 5 inches in diameter are treated with these methods because their bark often is too thick for basal sprays to penetrate. These treatments are also effective for lesser diameters. Frills or notches made by an ax into the sapwood, encircling the tree, act as cups to hold the herbicide. The frill can be filled with solutions of 2,4-D, dicamba, picloram, and triclopyr. Undiluted herbicides or AMS crystals (or a strong solution in water) can be used. There are also mechanical injection tools available that make the cut into the tree bark and inject the herbicide in one operation.

b. If trees are felled, the freshly cut stumps of sprouting species should be treated with the above herbicides to prevent sprouting. Most hardwood species will sprout after cutting.

3-11. Soil Treatments:

a. Herbicides are applied to the soil around and under woody plant canopies as dry granules or as water sprays. The soil should be moistened either by rainfall or irrigation shortly after herbicide application for best results. The herbicide must be one of those that are active through soil absorption and must be carried into the soil to be effective. Reduced effectiveness often results when there is a hot, dry season after treatment.

b. Herbicides can also be distributed in grid patterns or bands encircling the plants, or in any other suitable placement that will bring the herbicide into contact with the tree roots. Use strip applications to minimize damage to desirable grasses growing under and near trees to be killed.

c. Herbicides for soil treatment for brush control include: bromacil, picloram, and tebuthiuron.

d. Runoff water can carry herbicides to adjacent areas downslope and kill desirable plants.

Section D—Controlling Vegetation in Special Areas

3-12. Paved Areas. Vegetation that encroaches on the edges of concrete or asphalt pavement, or grows up through cracks and holes, causes premature breakdown of the pavement. Control with preemergence and postemergence applications of herbicides is possible.

a. Several herbicides can prevent the emergence of plants through cracks in pavement, but they vary in cost and in their potential to injure vegetation adjacent to the paving. Suitable herbicides can be selected from attachments 4 and 6 based on their activity and persistence in soil, and other characteristics. Bromacil, tebuthiuron, prometon, and borate-chlorate mixtures are recommended.

b. Shoulders immediately adjacent to the traffic way, medians separating divided highways, and islands at highway intersections are often surfaced with asphalt. On these and similarly lightly paved areas, apply soil-sterilant herbicides to the soil under the gravel base before it is "shot" with asphalt. Use the highest recommended rates in attachment 6. The herbicide should be incorporated into the soil to a depth of 4 to 6 inches, using a rototiller or disk. This will activate the herbicide and improve weed control.

c. Do not use herbicide under asphalt or concrete pavement where roots of existing or future landscaping shrubs and trees may extend into the treated areas.

d. Care should be exercised to prevent damage to desirable vegetation between the time of herbicide application and the time of paving. Drainage water running across treated areas can carry the herbicide to susceptible plants down slope.

e. Residual effectiveness of treatments under paving depends on the factors discussed earlier, but, because of only limited percolation of water from above, herbicides should remain effective under paving for 5, 10, or even more years.

f. Other treatments will be necessary to prevent encroachment of weeds from unpaved areas and to control vegetation growing up through cracks in old pavement. Weeds emerging through cracks can be killed by treatment with herbicides such as paraquat and glyphosate. These have no activity in soil, and they are not likely to injure adjacent plants through runoff water. Including 2 to 4 pounds per acre of oryzalin in such sprays will reduce establishment of subsequent germinating seedlings, especially the grasses. Oryzalin kills germinating seeds, is somewhat persistent in soil, but does not injure most established plants.

3-13. Roadsides and Rights-of-Way. Stump, basal-bark, and foliage applications are excellent for controlling brush and trees along roadsides and utility lines.

a. The greatest hazards in rights-of-way treatments are drift, runoff, improper application, and leaching to the roots of desirable species under the treated areas.

b. Runoff is an important hazard on slopes, bare ground, and pavements. Cutback asphalt, applied after application of a soil sterilant, helps hold the chemical in place. Desirable trees and shrubs some distance from soil treated with soil sterilants may be killed if their roots extend into this treated area.

c. Before spraying, make a survey of the area to locate slopes subject to erosion and desirable vegetation, and to determine size and density of brush to be controlled.

d. Cutting the trees and treating the stumps is most satisfactory for killing trees along roadsides, and for controlling brush over 30 feet tall. Considerable labor is required, but the danger from falling branches is removed, and there will be no standing dead trees.

e. Basal applications are practical for uncut brush and for regrowth from cut brush or trees. Make applications during the dormant season to avoid danger of injury from drift. There is less danger of injuring desirable plants during their dormant stage.

3-14. Weapons Ranges. When vegetation must be controlled on weapons ranges that contain unexploded ordnance, it may be cost-effective to apply herbicides aerially. Assistance may be obtained from the Air Force Aerial Spray Branch, 356 TAS/Aerial Spray, Rickenbacker ANGB OH 43217-5008, or commercial aerial applicators.

3-15. Railway Areas. Three distinct railway areas require weed control: the ballast, the roadbed, and the right-of-way.

a. The ballast is a 12- to 16-foot-wide strip, made up of coarse material such as cinders and gravel, that should be kept free of weeds. Because it is porous, it does not retain herbicides well. Insoluble herbicides, those absorbed

through the leaves, and contact herbicides are most suitable (attachment 6).

b. To obtain vegetation free areas, certain foliar-applied herbicides are used together with persistent, soil-applied herbicides. These foliar herbicides include the contact herbicide paraquat and the translocated herbicides such as glyphosate and amitrole. Glyphosate is nonselective and kills many weeds, including perennial weeds. It readily translocates from the foliage to other parts of the plant, including the roots. To broaden the spectrum of weed species controlled by persistent soil-applied herbicides, such as bromacil, add foliar herbicides such as 2,4-D, dicamba, and picloram to control broadleaf weeds.

c. If control is accomplished during the first 2 years by heavy rates of herbicide application, it can then be maintained with reduced rates. The full effectiveness of some soil sterilants like bromacil, tebuthiuron, diuron, and simazine is most evident in the second or third year of use, especially in dry areas or with deep rooted weeds.

d. The roadbed (berm) beyond the ballast requires weed control to prevent tall vegetation, but elimination of all vegetation increases chances of erosion. Low-growing grasses are acceptable. The rest of the area, to the right-of-way fence, is similar in weed control requirements to roadsides.